The Use of Composts to Enhance the Growth of Hardwood and Softwood Tree Seedlings in Substandard Soils

This study tested the hypothesis that composted products made from organic feedstocks have practical uses in forestry: first, to improve tree seedling survival and growth (especially in substandard soils) and secondly, to increase the area of CO_2 removal from the atmosphere through photosynthesis which also increases carbon sequestration in the woody segments of young forests. Participants were U.S. Forest Service, U.S. EPA Office of Solid Waste and the Forest Service at the Qualla Cherokee Reservation in North Carolina.

This pilot demonstration showed the effects of straw vs. 3 composts (biosolids compost, yard compost and total municipal solid waste compost) on the growth of hardwood and softwood tree seedlings planted in severely deficient soils. In the selection of tree seedlings for this demonstration it should be noted that hardwoods show very broad genetic variations, but pines have been extensively studied and developed for consistent genetic characteristics. So in order to observe a variety of tree seedling responses, two hardwoods and a softwood were used. Those selected were donated by the North Carolina State Nursery: white pine, chestnut oak, and a fruited hardwood, Chinese chestnut. Of course, American chestnut trees, which were 1 of every 4 hardwood trees before 1904, are no longer available due to blight.

In December 1994, the conifer seedlings used were 8-10 inches high and the hardwoods were 24 to 30 inches high. Seedling growth and natural volunteer vegetation were monitored from December 1994 to the summer of 1998. To protect tree seedling destruction from wildlife, there was no mowing done between trees or

weed removal of any type , chemical or manual. Composts and control straw mulches were applied to a thickness of 2 inches. The yard compost was donated by Compost Central of Charlotte, N.C. Biosolids compost was donated by Lexington, N.C., and total MSW compost was donated by Bedminster of Sevierville, Tenn. Straw was purchased from Robbinsville, N.C. U.S. Forester Joe Bonette monitored. Comparisons of ground cover, soil erosion, tree growth and survival data which showed distinct differences in the 4 treatments at 3 sites.

This is Ridge Top Site #1.

Yellow pine and upland hardwoods had been clearcut earlier for sale near ground level. Logging slash and debris were bulldozed off the test site. There were 8 test plots 12 ft W x 32 ft L on the SE face of the ridge and 8 identical plots on the NW face. Slope averaged about 35% and silt fences for erosion tests were placed at the downhill edges of the plots. Soil samples were taken before treatments at 5-inch depths. 30 white pines were planted in 4 plots on both faces of the ridge top. Each of the 4 plots had either straw or one of the 3 composts for a total of 240 pines. Similarly, 240 chestnut oaks and 240 Chinese chestnuts had the same 4 test materials distribution but were planted in holes 6" x 12" deep made by a hand-held power auger.

This is Log Landing Site #2.

Compacted barren soil resulted from trucks and tractors during previous lumber harvests. At this site 240 Chinese chestnut tree seedlings were planted in 8 plots. 8 of these plots had 2 inches of either straw or one of the 3 composts disked under before planting. 4 of these plots also had 2 inches of the same materials added as a mulch for a total of 4 inches of test material. This shows barren Site #2 with volunteer

vegetation growing where a biosolids compost pile had been placed 6 months earlier. Site #3 was a North slope within the Qualla Cherokee Reservation which had lost most of its topsoil In the 4 plots 12" x 32' long, the 4 test materials were disked under.

After the Chinese chestnut trees had been planted in 6" x 12" holes, a 2-inch mulch of the same materials were added on the surface. However, an additional pickup truckload of MSW compost had been ordered from Bedminster, but a large 8 wheel truckload was sent instead. Site #3 was compromised when a 1-inch layer of MSW compost was mistakenly spread over all 4 test sites including the straw control. No further monitoring of Site #3 occurred for 2 years.

Findings:

After the first year, erosion silt was visible against the black silt fence in untreated soil; but no erosion silt was seen at the downhill edge of many of the 4 two-inch treatments at Ridge Top Site #1. In the 2nd and 3rd years, both 2-inch straw mulch and untreated soils showed erosion silt at the fencing.

The Nantahala Forest area had been severely affected by the chestnut blight so that none survived. Even though the Chinese chestnut variety has blight resistance, the survival rate of the Chinese chestnut in the 3 composts and straw plots averaged 63% survival, with biosolids compost best at 75%. The virus cankers were visible on the Chinese chestnut seedlings that died with stunted growth within 2 years.

At the end of 3 years without weed control, volunteer herbaceous ground cover was heavier in all composts compared to straw plots. The average covers were: biosolids compost 95%, yard compost at 80%, MSW compost at 60% and straw control at 50%.

After 3 years, the organic components of the compost treated soils were 140% greater than those of the untreated soils. The micronutrients manganese, copper and zinc were significantly higher in the compost-treated plots. Before planting, the phosphorus in soil was 0 with the methods used.

The dark green color difference between the pines with compost treatment and those with the straw treatment was clearly visible. An important and surprising difference was also seen in the growth of pines compared to hardwoods. Pines showed the best survival and growth with yard compost; but the hardwoods showed best growth and survival with MSW compost.

Growth:

After 2 years, the Cherokee reported unusual growth in Site #3. The forester visited the site and photographed the Chinese chestnut trees with an average height of about 10 feet.

After the 3rd year, the site was photographed again and the height recorded was about 15 feet. [A mature Chinese chestnut tree reaches an average of 25 feet at full growth.]

The photographed plot had 2 inches of yard compost disked under; trees were then planted in 6" x 12" holes, and 2 inches of yard compost mulch were added to the plot. In addition the error of 1 inch of MSW compost had also been added as a second mulch. Unfortunately, the biosolids compost was tested in a private lab, the MSW was tested in a Tennessee State soil lab, and the yard compost was tested in a North Carolina soil lab and were not comparable.

A more extensive and carefully controlled tree growth project is being planned in

low-nutrient soils in cooperation with the USDA Agricultural Research Service of Beltsville, MD. The USDA laboratories will be used for all analyses and composts will be compared to the U.S. Composting Council Quality Assurance Standards.